November 20, 1894.

Sir W. H. Flower, K.C.B., LL.D., F.R.S., President, in the Chair.

The Secretary read the following report on the additions to the Society's Menagerie during the month of October 1894:—

The total number of registered additions to the Society's Menagerie during the month of October was 103, of which 66 were acquired by presentation, 12 by birth, 14 by purchase, 4 by exchange, and 7 were received on deposit. The total number of departures during the same period, by death and removals, was 108.

Amongst the additions are a pair of Somali Ostriches (*Struthio molybdophanes*), from Somaliland, purchased Oct. 26th. This is the first pair of the blue-skinned form of Ostrich, which inhabits Eastern Africa, that has reached us. These birds have been placed in the Giraffe-House, along with a pair of the ordinary form and with an example of a curious pied variety of the Ostrich, deposited by the Hon. W. Rothschild, F.Z.S.

The Secretary exhibited, on behalf of Dr. C. Kerbert, C.M.Z.S., a photograph of a Mountain-Antelope (*Nemorhædus sumatrensis*) from a specimen living in the Gardens of the Royal Zoological Society of Amsterdam, and remarked that he had never seen a living example of this rare animal, and that specimens of it in Museums were very scarce.

Mr. R. Lydekker exhibited photographs and a model of a unique egg, the original of which had been obtained many years ago in Southern Patagonia, and was now preserved in the Museum at La Plata. If not an abnormal specimen, it could not be assigned to any known species of bird.

When travelling in the district where the specimen was obtained, Dr. P. Moreno, Director of the Museum at La Plata, many years ago saw numbers of small Ratite birds, which he at first took to be small Rheas. By the natives, to whom they were well known, he was, however, assured that they were adult birds, allied to the Rheas. Desirous of confirming this information, Dr. Moreno applied to a friend acquainted with the district; who replied that not only did he well know the birds, but that he possessed an egg, that egg being the original specimen of which a model was now exhibited.

Assuming the egg to be a normal one, Mr. Lydekker was of opinion that, taken in connexion with the evidence of two independent witnesses who had seen the birds, it pointed to the existence in Southern Patagonia of a small unknown Ratite bird more or less nearly allied to the Rheas.

Mr. Tegetmeier exhibited the felted covering of a long-haired

Angora Rabbit which had shed its entire coat in one piece for two years in succession. This seemed to show an analogy in a mammal to the simultaneous moulting of certain birds.

Sir William Flower exhibited a specimen of a Hairy Armadillo (*Tatusia pilosa*), obtained by M. J. Kalinowski in the Maraynioc district of Central Peru. It had been acquired by the British Natural History Museum in exchange from the Branicki Museum, Warsaw, through the kind offices of Dr. Stolzmann. In dimensions and other characters it exactly resembled the specimen belonging to the Scarborough Museum, that Sir William Flower had brought before the Society on November 16, 1886 (see P. Z. S. 1886, p. 419), which was identified with *Cryptophractus pilosus* of Fitzinger (32te Versamml. deutsch. Naturf. u. Aerzte, 1856, Tageblatt No. 6, S. 123), and with *Praopus hirsutus* of Burmeister.

A communication from Mr. J. T. Cunningham treated of the significance of diagnostic characters in the Pleuronectidæ. In this paper the specific and generic characters of the so-called Top-knot (*Zeugopterus*) were first considered. The principal generic characters were the perforation of the gill-septum, found also in *Arnoglossus megastoma*, and the prolongation of the dorsal and ventral fins on to the right side at the base of the tail. The marked peculiarity of habit was that of adhering to vertical surfaces. It was shown that this was independent of either of the characters mentioned, and was due to the pumping-action of the longitudinal fins and their muscles posteriorly, the enlargement of these parts being also a generic character. No evidence of the utility of the specific characters could be discovered. The characters of other Pleuronectidæ were similarly examined, and the conclusion reached was that there are two kinds of characters, the adaptive and the morphological.

The following papers were read :—

1. A Description of the so-called Salmonoid Fishes of the English Chalk. By A. Smith Woodward, F.Z.S.

[Received November 6, 1894.]

(Plates XLII. & XLIII.)

It is remarkable that among British fossils many of the commonest and most typical species have been the least satisfactorily studied and described. Among fishes this is more especially the case, and none have received less attention than those of the English Chalk. Some of them, such as the so-called

Salmonoids, have been assiduously collected since the days of Mantell, and are well represented in many museums; but nothing of importance with reference to their osteology has been published within the last half-century. It is impossible to make further progress in comprehending the fish-fauna of the Cretaceous period until a detailed study of all the known skeletons has been accomplished; and it is the object of the present communication to begin such a review of the materials at present available for discussion.

A beginning is made with the so-called Salmonoids of the English Chalk, because these have been the least elucidated by recent discoveries in corresponding strata elsewhere. The great Sauroid fishes like *Portheus* and the long-snouted *Protosphyræna* have been discovered in perfection in the Chalk of North America, while *Enchodus* and *Dercetis* have been found beautifully preserved in Westphalia and the Lebanon; but tolerably complete specimens related to the supposed Salmonoid *Osmeroides* are known only from the Chalk of Bohemia, and as these exhibit merely natural casts of the actual fossil they are comparatively unsatisfactory for study.

The generic name *Osmeroides* was originally given by Agassiz to some fishes from the Cretaceous of Westphalia, regarded by Pictet and the present writer as undoubted Scopeloids. Many examples of these species exhibit very distinctly the characteristic exclusion of the maxilla from the margin of the upper jaw; and they have few, well-spaced branchiostegal rays, without any gular plate. When the same name was afterwards applied to fossils discovered by Dr. Mantell in the English Chalk, it was expressly stated by Agassiz that the determination of generic identity was uncertain and provisional; and the following description will demonstrate that the Westphalian and English fishes in question belong even to distinct families. Although Agassiz himself hesitated to distinguish between Salmonoids and Clupeoids when dealing with fossils, preferring to combine them in one family "Halecidæ," subsequent authors appear to have unanimously assigned the English *Osmeroides lewesiensis* to the Salmonidæ. It is thus of much interest to turn to a detailed examination of the known specimens.

1. Osmeroides lewesiensis. (Plate XLII.)

Osmeroides lewesiensis, L. Agassiz, Poiss. Foss. vol. v. pt. i. p. 14, pt. ii. p. 105, pl. lx. *b*. figs. 1, 2, 5–7 (*nec* figs. 3, 4), pl. lx. *c*. (1834–44); A. S. Woodward, Proc. Geol. Assoc. vol. x. p. 322 (1888).

Salmo lewesiensis, G. A. Mantell, Foss. South Downs, p. 235, pl. xxxiii. fig. 12, pl. xl. fig. 1 (1822).

Osmeroides mantelli, L. Agassiz, Neues Jahrb. f. Mineral. 1839, p. 121 (name only); G. A. Mantell, Wonders of Geology, ed. 3, vol. i. p. 427 (1839).

Though many of the smaller features in the skeleton of this fish still remain to be discovered, nearly all its principal characters can now be ascertained. The beautiful series of specimens in the

British Museum exhibit both the head and trunk with fins, and these form the basis of the following detailed description.

The hinder half of the cranial roof, the facial and opercular bones, and the upper branchiostegal rays are ornamented with rugæ, mostly radiating. The cranial roof is flattened, with a faint tendency to a depression mesially, and the occipital border is excavated by a re-entering angle. The *parietal* bones (Plate XLII. fig. 2, *pa.*) are relatively small, longer than broad, and meet throughout their length in the median line, excluding the supra-occipital from the roof. The *squamosals* (fig. 2, *sq.*) flank the parietals, forming the postero-external angle of the cranial roof, and produced forwards a little along the outer margin of the frontals. The *frontals* (figs. 2, 3 *a*, *fr.*) are very large, broad, and rugose behind, tapering and nearly smooth forwards. In their hinder half the median suture between them is feebly dentated; the anterior extremity of each exhibits a Λ-shaped excavation (fig. 3 *a*). Occupying an indent in the outer margin of each frontal above and partly in advance of the orbit is a rugose elongated membrane-bone covering the prefrontal region, which is perhaps best named *supraorbital* (fig. 2, *sp.o.*). The depressed and expanded *ethmoidal region* (fig. 3 *a*, *eth.*) is widest at the palatine articulation. The *supraoccipital* exhibits a large vertical keel on its hinder face, but neither the occipital nor otic elements are sufficiently well displayed for description. In the pterygo-palatine arcade the *quadrate* (figs. 3, 4, *qu.*) is often seen. It is triangular in shape, with a robust articular head, and an upwardly directed process arising from the lower end of its hinder border, clasping the thick styliform *symplectic* (fig. 4, *sym.*). The whole of its upper margin is apposed to the thin triangular *metapterygoid* (figs. 3, 4, *m.pt.*), and its anterior edge is similarly in contact with the downwardly curved hinder extremity of the *ectopterygoid* (fig. 3, *ectp.*). The twisted and expanded *hyomandibular* is also shown in one specimen, reaching the upper end of the symplectic; and there are remains of a relatively large and thin, antero-posteriorly elongated *entopterygoid*. In specimen no. P. 5680 there is evidence of minute clustered, pointed teeth on some thin internal bone; and this may have been either ecto- or ento-pterygoid. The *maxilla* (figs. 3, 5, *mx.*) is robust and arched, with a large upwardly directed process at its anterior end and a convex oral margin. The upper portion is overlapped by two large *supramaxillaries* (figs. 3, 5, *s.mx.* 1, 2), the hinder the deepest, and sending a narrow process forwards above the upper margin of the anterior plate. The *premaxilla*, underlapping the maxilla, is small, and both this and the maxilla are provided with very minute clustered teeth. The *dentary* portion of the mandible (figs. 5 *a*, 6, *d.*) is very robust at the symphysis, with a cluster of minute teeth in several series; the points of attachment of these teeth are shown in fig. 5 *a*. The dentary rises in the coronoid region, and its hinder margin is excavated for the reception of the large *angular* (fig. 6, *ag.*). The lower border of the mandible is slightly bent inwards; and just

below the angle there extends the sensory canal, opening by a series of pores (seen in Brit. Mus. nos. 4294, P. 6456). There are two large *postorbital cheek-plates* (fig. 3, *pt.o.*), thinner than the other external bones (except the gular plate), and there are also remains of *suborbitals* extending to the anterior border of the preoperculum.

The opercular apparatus is complete and the bones are robust. The *operculum* (fig. 3, *op.*) is trapezoidal in form, about two-thirds as broad as deep, and marked with coarse branched rugæ radiating from the point of suspension. The *suboperculum* (fig. 3, *s.op.*), likewise ornamented, is almost sickle-shaped and deeply overlapped by the operculum, and bears a large ascending process at its antero-superior angle. The *interoperculum* is small, smooth, and much overlapped. The *preoperculum* (fig. 3, *p.op.*) is sharply angulated and marked with radiating rugæ. There are not less than eighteen *branchiostegal* rays (as shown by B.M. no. P. 5680), the uppermost large, broad, and rugose; and five of these are supported by the epihyal. In advance of the branchiostegal rays, between the rami of the mandible, there is also a conspicuous *gular plate* (fig. 1, *gu.*), remarkably thin and elongated, but shown both in the specimen figured and in others in the British Museum numbered 4207, 4296, 4299, and 49891.

The axis of the trunk is only imperfectly known. The *vertebral centra* are strengthened by secondary calcifications in the form of small irregular longitudinal ridges; those of the anterior abdominal region and the hinder caudal region are deeper than long, while the remainder are about as long as deep. *Ribs* are observable, and there are much thickened neural and hæmal arches fused with the centra towards the base of the tail (B.M. no. 4303). Some styliform bones in the abdominal region of no. 49892 also appear to be *intermuscular* elements.

There is nothing worthy of remark in the pectoral arch, of which the long *supraclavicle* and relatively large and smooth *clavicle* are shown in a British Museum specimen, no. P. 5680. The *pectoral fin-rays* (fig. 1, *pct.*) are unjointed for a considerable distance proximally, and the foremost ray (shown in B.M. no. 49894) exhibits an oblong expansion at its base of attachment. The rays of the *pelvic fins* (fig. 1, *plv.*) are not less than 11 in number and are similarly only divided quite at the distal end; their supporting elements are unknown. The *dorsal fin*, placed in the middle of the back, opposite to the pelvic pair and arising somewhat in advance of the latter, is incompletely known, but consists of robust rays unjointed for a long distance proximally, very closely divided at the distal end; the supports (shown in B.M. no. 49892) are large and dagger-shaped, having wide "wings." The *anal fin* (fig. 1, *a.*) is small and remote; the *caudal fin* appears to have been forked (B.M. no. 49891).

The *scales* are very deeply overlapping, the covered portion being marked by few radiating grooves terminating at the anterior truncated margin. The posterior border is gently rounded, and

the exposed portion of the scale sometimes shows only the concentric lines of growth, sometimes is ornamented with very fine closely-arranged radiating lines of tubercles. The latter ornamentation is probably normal and varies with the state of abrasion of the fossil. The scales of the *lateral line* are not enlarged; the course of the sensory canal is marked by a feeble ridge and a notch in the hinder border of most of the scales.

2. Elopopsis crassus. (Plate XLIII. figs. 1, *a–c*.)

Osmeroides crassus, F. Dixon, Geol. & Foss. Sussex, p. 376 (1850); A. S. Woodward, Proc. Geol. Assoc. vol. x. p. 322 (1888).

The name of *Osmeroides crassus* was given by Dixon to a unique specimen from the Chalk of Sussex now in the Brighton Museum, but the fossil has hitherto been only briefly noticed without detailed description. The writer has thus availed himself of the kindness of Henry Willett, Esq., and the ex-Chairman of the Museum Committee (Edward Crane, Esq.), to examine the original specimen more closely. It comprises the head with the anterior part of the abdominal region of a large fish, much fractured and crushed and exhibiting part of the pectoral fin on the left side. The right side of the head is represented in Pl. XLIII. fig. 1; an upper view of the ethmoidal region is given in fig. 1*a*; and separate drawings of the left premaxilla and dentary are given in figs. 1 *b*, *c*.

The superficial bones exhibit no ornamentation, merely the lines of growth and in places sensory canals. The cranial roof is much crushed and fractured and thus too imperfect for description. The great extent of the *frontals*, however, is well shown, and the much-expanded and truncated *ethmoid* (fig. 1 *a*, *eth.*) is completely preserved. The *postorbital* plates (fig. 1, *pt.o.*) cover the cheek between the orbit and the preoperculum, and there are also remains of well-developed *suborbitals* (*s.o.*). The *premaxilla* (figs. 1, 1 *b*, *pmx.*) is relatively small, elongate-triangular in shape, and furnished on its oral margin with a close series of small conical teeth. Within the mouth, and apparently fixed on the same bone, are also two much-enlarged teeth, laterally compressed but without trenchant edges; the foremost, placed at the anterior end of the bone and shown only by the base, is the smaller of the two; the second, well-preserved on each side, occurs at about the middle of the bone. In the fossil the anterior ends of the premaxillæ are widely separated, but this may be due to crushing. The *maxilla* (fig. 1, *mx.*) is very large, extending backwards beyond the orbit, and overlapped above by either one or two *supramaxillary* bones (*s.mx.*), which are too much crushed for description. The oral margin of the bone is convexly arched, and in the fossil curves slightly inwards; it bears a single regular series of very short and stout conical teeth, larger than the marginal teeth of the premaxilla, and there are appearances of a second series of smaller teeth occuring immediately within. The *dentary* bone of the mandible (fig. 1 *c*) is deep behind and tapers rapidly to an almost pointed symphysis; it bears a single series of well-spaced, large, conical

teeth, laterally compressed but without trenchant edges. There is also a pair of still larger teeth of a similar character immediately within the symphysis of the mandible. All the teeth are smooth. The *preoperculum* (fig. 1, *p.op.*) is relatively thin, broad at its angle, and marked with radiating sensory canals. The limits of the *operculum* and *subopercuhum* are not quite clear; and of the *branchiostegal rays* it can only be said that they are numerous, perhaps about 20 on each side. A *gular plate* may or may not have been present, but no remains of it are preserved.

The centra of the anterior abdominal vertebræ are deeper than long, and strengthened by peripheral secondary calcifications in the form of irregular longitudinal ridges. The scales are large and smooth.

As shown by the characters of its dentition, the fossil thus described evidently pertains to a genus distinct from that to which *Osmeroides lewesiensis* is referred. In the absence of the trunk, however, it is difficult to determine its precise position; and it can only be said to approach most nearly the *Elops*-like fishes from the Chalk of Bohemia and Dalmatia to which the generic name *Elopopsis* has been applied. It agrees with these especially in the nature of the dentition, the form of the mandible, and the characters of the preoperculum. As a temporary expedient, the Brighton fossil may therefore bear the name of *Elopopsis crassus*.

3. Aulolepis typus. (Plate XLIII. figs. 2–6.)

Aulolepis typus, L. Agassiz, Poiss. Foss. vol. v. pt. i. p. 14, pt. ii. p. 109, pl. lx.*a*. figs. 5–8 (1834–44); A. S. Woodward, Proc. Geol. Assoc. vol. x. p. 324 (1888).

Another generic type from the English Chalk commonly regarded as a Salmonoid is named *Aulolepis*. Only a single species, *A. typus*, is known; but this is represented by so large a series of specimens in the British Museum that it makes an important contribution to our knowledge of the osteology of the Cretaceous physostomatous fishes.

The head is known almost exclusively by the external bones. The cranial roof (fig. 2) is flattened mesially, but somewhat arched downwards at the lateral margin; and the occipital border is either straight or with a slightly re-entering angle. The *supra-occipital* exhibits a median vertical keel on its hinder face, but the bone is almost or quite excluded from the superior aspect of the skull. The *parietals* (*pa.*) meet in an irregular wavy suture, as also does the hinder portion of the *frontals* (*fr.*), and the former bones scarcely attain one-third of the length of the latter; the transverse suture between these two pairs of elements is likewise unsymmetrically wavy. The *squamosals* (*sq.*) are as broad as the parietals, but extend further forwards on the outer margin in a narrow process. Each frontal (fig. 3) is very broad behind and much tapering in front, while the longitudinal sensory canal opens on its surface in a series of small pores. The *ethmoidal region* of the cranium can only be described as narrow, not much expanded at the extremity.

The *cheek-plates* are large, but comparatively thin; and the only evidence of ornament consists in radiating lines on the large postero-inferior suborbital (B.M. nos. 49903, P. 5681). The *maxilla* is very robust and arched so that the oral margin is convex (fig. 4, *mx.*). Anteriorly it is produced upwards and inwards as a long narrow process (*p.*) above the premaxilla towards its attachment in the front of the ethmoidal region; the upper portion is a thin lamina overlapped by two supramaxillary plates (figs. 3 *a*, 4, *s.mx.*), of which the hindermost is deepest and has an anteriorly directed process at its front upper angle. The *premaxilla* (fig. 4, *pmx.*) is shown to have been moderately extended beneath the maxilla. The mandible is deepest in the coronoid region, and the *angular* element (fig. 2 *a*, *ag.*) is very large, extending for a length of more than two-thirds that of the *dentary* (*d.*) on the outer surface. The inferior border of the ramus is slightly bent inwards, and along the angle thus formed the sensory canal opens in a longitudinal series of small pits (fig. 5). The teeth are very minute and clustered on the margin of both jaws.

Behind the occipital on each side there is a small *supratemporal* plate, and partly covered by this is a large *post-temporal* element. The *operculum* (fig. 5, *op.*) is trapezoidal in form, nearly twice as deep in front as behind. The *subopercŭlum* (*s.op.*) is somewhat less than half as deep as the latter, and has a prominent ascending process at its antero-superior angle. The *preopercŭlum* (fig. 4, *p.op.*) is well exposed, with the inferior limb sharply bent forwards; and its outer face is marked by a sharp vertical ridge giving rise to a few radiations at the angle. The *interopercŭlum* (fig. 5, *i.op.*) is long and narrow, and the *branchiostegal rays*, shown to the number of eight or nine in fig. 5 (*br.*), are broad. It is also interesting to observe that between the rami of the mandible (fig. 5, *d.*) there is a long narrow azygous *gular plate* (*gu.*), quite smooth on the outer face and regularly rounded at each end.

One specimen (no. 47932) exhibits at the back of the head remains of a close series of small styliform bones, acutely pointed at the anterior end, attached by a slight expansion at the hinder end. These are probably *gill-rakers*.

The *vertebral centra* are robust and the secondary lateral ossifications are in the form of delicate longitudinal ridges. Appearances in nos. 49903 and P. 4247 suggest that there was a perforation in the middle of each centrum allowing for the passage of a persistent thread of notochord; while it is clear that the neural arches throughout and the hæmal arches in the caudal region are fused with the supporting centra. *Ribs* also are seen in the abdominal region, not extending quite to the ventral border. The number of vertebræ cannot be counted, but there seem to have been not less than twenty in the abdominal region. The anterior abdominal vertebral centra are deeper than long—those most posteriorly at least as long as deep.

The *pectoral arch* is obscure, but the remains, shown from the inner aspect in fig. 6, exhibit the relatively large elongated *supra-*

clavicle (*s.cl.*) and the arched *clavicle* (*cl.*) expanded at its lower end. Posteriorly may also be seen the large *scapula* (*sc.*), pierced by an oval foramen. The *pelvic arch* (fig. 6, *plv.*) is of the ordinary form, the two halves separate, each expanded at the origin of the fin and tapering forwards. It is situated in a remarkably advanced position, for the figured specimen seems to show that the anterior fins represented in the type specimen are truly the pelvic pair; while each of these fins is very well developed and comprises not less than eight rays[1]. The dorsal fin (fig. 2, *d.f.*) occupies about the middle of the back and seems to comprise two or three spinous rays anteriorly.

The *anal fin* is small and remote, consisting of robust rays which are unjointed for a considerable length at their base.

The *scales* are thick, cycloid, and very deeply overlapping; the external markings are merely those produced by the concentric lines of growth, but there are a few traces of radiating lines and crimping in the covered portion. The peculiar longitudinal elevations, described by Agassiz as marking the course of the "lateral line," are apparently confined to the scales of the caudal region.

4. Acrognathus boops.

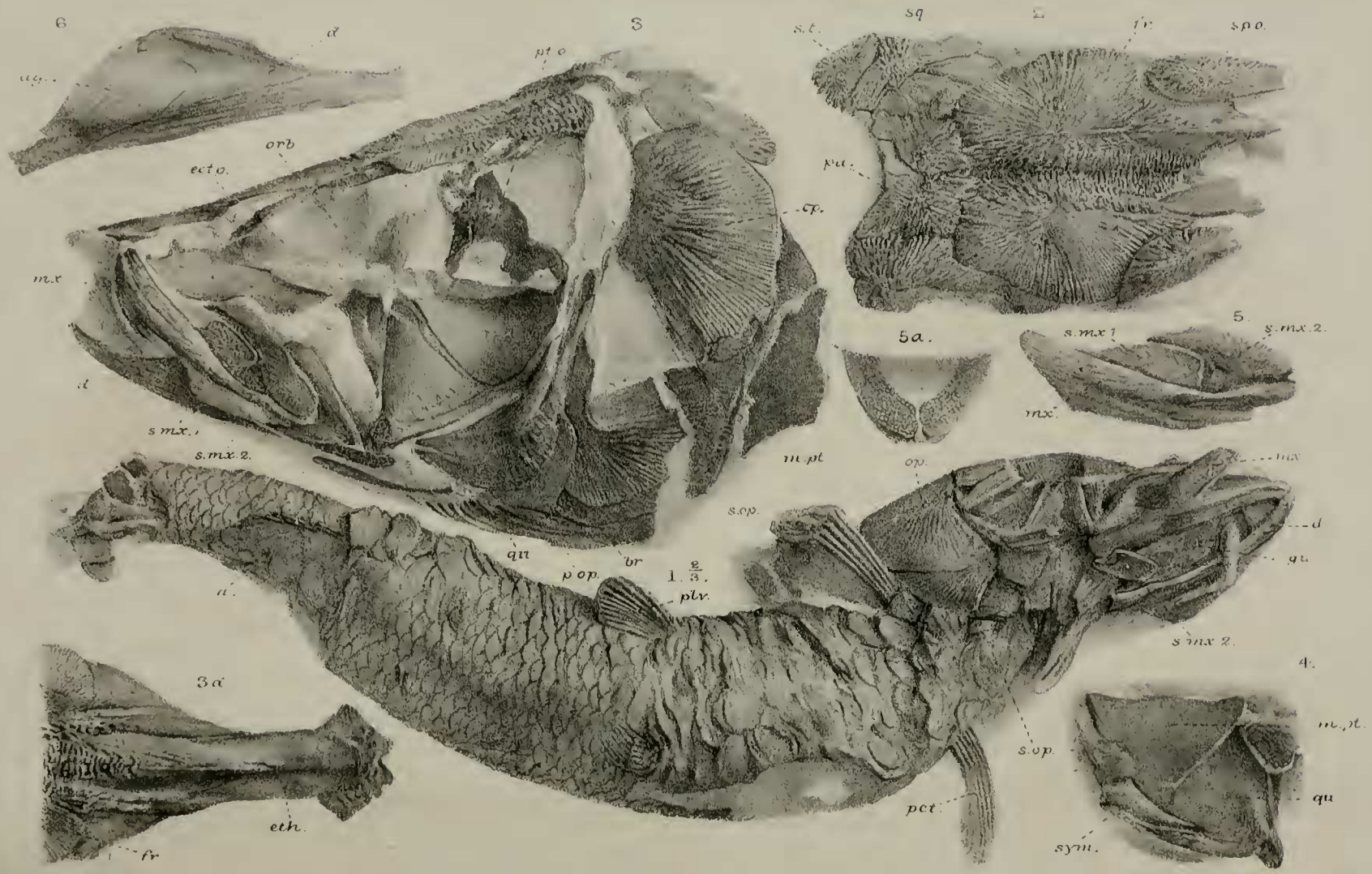
Acrognathus boops, L. Agassiz, Poiss. Foss. vol. v. pt. i. p. 14, pt. ii. p. 108, pl. lx. *a.* figs. 1–4 (1834–44); A. S. Woodward, Proc. Geol. Assoc. vol. x. p. 323 (1888).

No new evidence is forthcoming as to this supposed deep-sea Salmonoid. It is represented in the British Museum only by the type specimen and a fragment.

Conclusion.

In determining the systematic position of these fishes from the English Chalk it is, of course, impossible to refer to the most distinctive external feature by which Salmonoids can be separated from Clupeoids. The nature of the matrix would not admit of the preservation of an adipose dorsal fin, even if it were originally well-developed. Three osteological characters of *Osmeroides* and *Aulolepis*, however, now made known for the first time, combine to suggest comparisons only in one direction, namely, with the modern genera *Elops*, *Megalops*, and their extinct allies. These characters are:—(i.) the union of the parietal bones mesially to the exclusion of the supraoccipital from the cranial roof; (ii.) the arched maxilla overlapped above by two large supramaxillary bones; and (iii.) the presence of a large gular plate. It is true that although in the typical Salmonidæ the supraoccipital separates the parietals on the cranial roof, there are rare instances (*e.g.*, *Thymallus*) in which the parietals are in contact throughout their

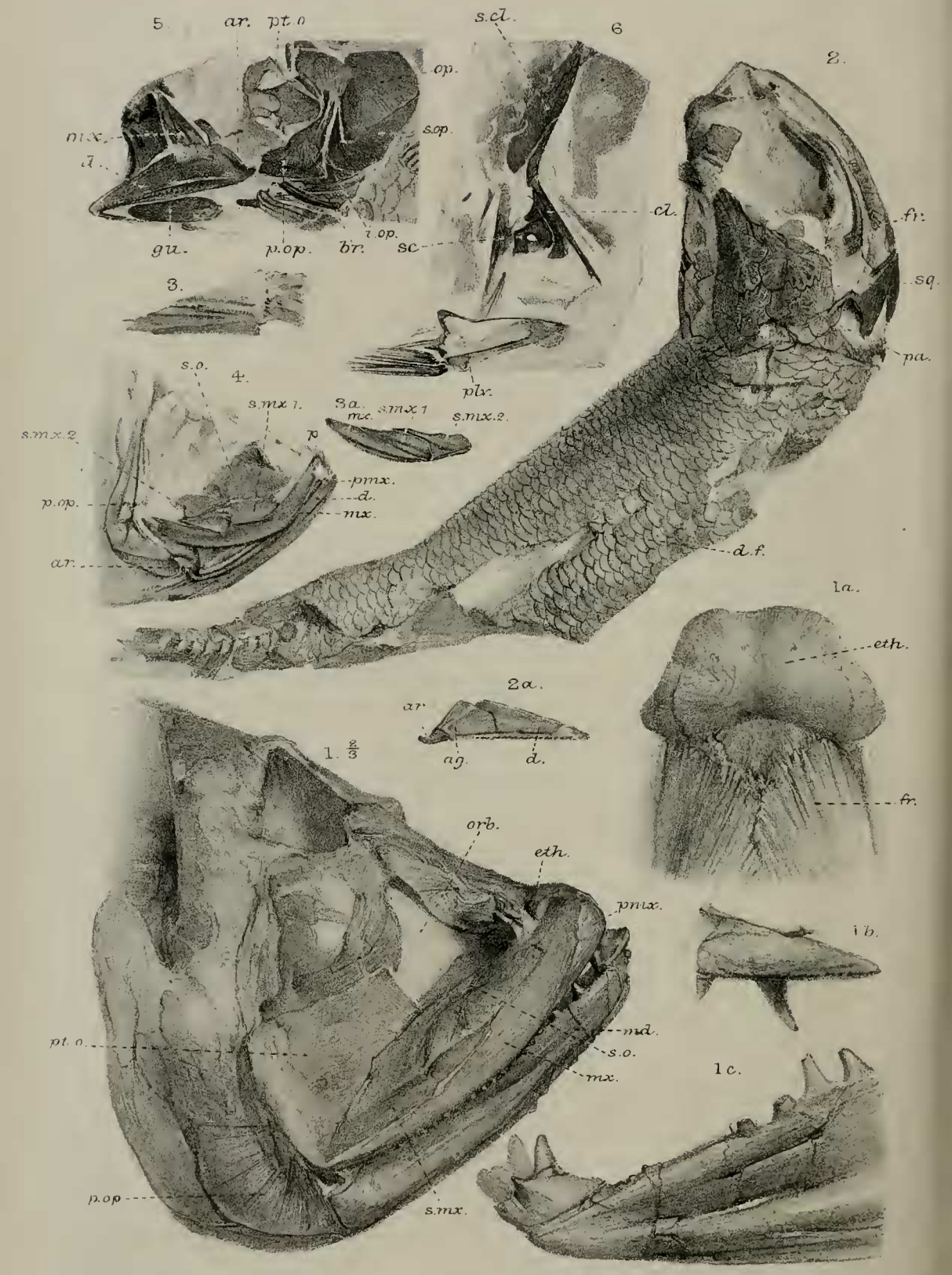
[1] Since this paper was read the writer has observed a specimen in the Woodwardian Museum, Cambridge (Forbes-Young collection), in which the pelvic fins are beautifully preserved in the advanced situation here described.



F H Michael del et lith

West, Newman imp

Osmeroides lewesiensis.



F H Michael del et lith.

West, Newman imp.

1. Elopopsis crassus.
2-6. Aulolepis typus

length. Further, it is known that the double supramaxilla is not quite constant in the Clupeoids, Elopines, and their allies. It may also be argued that, as Dr. Günther admits to the Clupeidæ living fishes with a gular plate (*Elops*, *Megalops*), there is no reason for excluding from the Salmonidæ any primitive fishes which differ only from the living members of this family in the possession of such a plate. Nevertheless, so far as the present writer is aware, supramaxillaries of the form described above in *Osmeroides* and *Aulolepis* have not hitherto been observed in any Salmonoid, while they are a very common feature among Clupeoids and Elopines. The two Cretaceous genera under discussion may therefore be provisionally associated with the latter. The fishes named *Osmeroides* from the Chalk of Mount Lebanon may also be placed here, for they likewise exhibit a large gular plate; and *Elopopsis* is already assigned to the same systematic position by common consent. *Elops* and *Megalops*, indeed, have many more close allies in Cretaceous and early Tertiary strata than has hitherto been suspected, and the type they represent seems to have been dominant among the earliest Physostomi.

EXPLANATION OF THE PLATES.

Plate XLII.

Fig. 1. *Osmeroides lewesiensis*; fish from ventral aspect, two-thirds nat. size. *a.*, base of anal fin; *d.*, dentary; *gu.*, gular plate; *mx.*, maxilla; *op.*, operculum; *pct.*, pectoral fins; *plv.*, pelvic fins; *s.mx.*2, posterior supramaxillary; *s.op.*, suboperculum. [P. 7188.]

2. Ditto; hinder portion of cranial roof, upper aspect. *fr.*, frontal; *pa.*, parietal; *s.t.*, supratemporal; *sp.o.*, supraorbital; *sq.*, squamosal. [4295.]

3. Ditto; side view of head. 3 *a*. Rostral region of same specimen, upper aspect. *br.*, branchiostegal rays; *m.pt.*, metapterygoid; *d.*, dentary; *ectp.*, ectopterygoid; *eth.*, ethmoid; *fr.*, frontal; *mx.*, maxilla; *op.*, operculum; *orb.*, orbit; *p.op.*, preoperculum; *pt.o.*, postorbital; *qu.*, quadrate; *s.mx.* 1, 2, supramaxillaries; *s.op.* suboperculum. [4296.]

4. Ditto; right quadrate (*qu.*), metapterygoid (*m.pt.*), and symplectic (*sym.*), outer aspect. [P. 5680.]

5. Ditto; left maxilla (*mx.*) and supramaxillaries (*s.mx.* 1, 2), outer aspect. 5 *a*. Symphysis of mandible, oral aspect, showing attachment of teeth. [49891.]

6. Ditto; right mandibular ramus, outer aspect. *ag.*, angular; *d.*, dentary. [4296.]

Plate XLIII.

Fig. 1. *Elopopsis crassus*; lateral view of head, two-thirds nat. size. 1 *a*. Upper view of ethmoidal region. 1 *b*. Left premaxilla, outer aspect, 1 *c*. Left dentary, outer aspect. *eth.*, ethmoid; *fr.*, frontal; *md.*, mandible; *mx.*, maxilla; *orb.*, orbit; *p.op.*, preoperculum; *pmx.*, premaxilla; *pt.o.*, postorbital; *s.mx.*, supramaxillary; *s.o.*, suborbital. [Willett Collection, Brighton Museum, no. 61.]

2. *Aulolepis typus*; imperfect fish, dorsal aspect. 2 *a*. Right mandibular ramus. *ag.*, angular; *ar.*, articular; *d.*, dentary; *d.f.*, dorsal fin; *fr.*, frontal; *pa.*, parietal; *sq.*, squamosal. [P. 5681.]

3. Ditto; right frontal, upper aspect. [P. 1854.]

Fig. 4. *Aulolepis typus*; head, right lateral aspect. *p.*, palatine process of maxilla; other letters as above. [P. 4247.]

5. Ditto; head, left lateral aspect, with gular plate (*gu.*). *br.*, branchiostegal rays; *i.op.*, interoperculum; *op.*, operculum; *s.op.*, subopercular; other letters as above. [49903.]

6. Ditto; pectoral and pelvic arches. *cl.*, clavicle; *plv.*, imperfect pelvic bone with fin; *s.cl.*, supraclavicle; *sc.*, scapula. [47932.]

All the specimens were obtained from the English Chalk, and unless otherwise stated the figures are of the natural size. Except the original of Pl. XLIII. fig. 1, the specimens are preserved in the British Museum, and the numbers placed in brackets refer to the Register of the Geological Department.

2. On the Gastropod *Colpodaspis pusilla* of Michael Sars.

By Walter Garstang, M.A., F.Z.S., Fellow and Lecturer of Lincoln College, Oxford.

[Received November 20, 1894.]

(Plate XLIV.)

The mollusk which forms the subject of the present communication has been so rarely seen, and presents such interesting peculiarities, that no apology is needed for the description of a new specimen. In the main my observations confirm those of the discoverer of *Colpodaspis*, Michael Sars; but the few points in which I have to modify, or supplement, Sars's interpretations seem to render the position and relations of the genus somewhat clearer than has hitherto been the case.

The literature on *Colpodaspis pusilla* is not extensive, as the only original observations on the creature are contained in Sars's memoir [1] on the fauna of the Christiania fjord. Two specimens were found by Michael Sars at Dröbak, one in August 1864 at a depth of 70–80 fms., the other in June 1865 at a depth of 20 fms. A slightly larger specimen was obtained a little later by G. O. Sars at Horten in 14–20 fms. Since the capture of these Norwegian specimens thirty years ago no additional individuals appear to have been obtained until on Feb. 21st of the present year (1894) I found [2] a specimen in the results of a day's dredging in the immediate neighbourhood of Plymouth, about two miles south of the Mewstone, at a depth of some 15 fms. The ground was rough, and consisted of hard clean red sandstone covered with *Caryophyllia*, with which were associated *Sertularia argentea*, *Henricia* (*Cribella*) *sanguinolenta*, and a sponge resembling Bowerbank's figure of *Isodictya dissimilis* (Brit. Spong. iii. pl. lv.).

This Plymouth individual was one eighth of an inch (3·125 mm.) in length. In colour it was snow-white, speckled with opaque white spots. When the animal was inverted, a position which it

[1] M. Sars, Bidrag til Kundskab om Christianiafjordens Fauna, ii. (Christiania, 1870), pp. 70–74, plate xi. figs. 1–6.

[2] Garstang, "Faunistic Notes at Plymouth during 1893–94," Journal Mar. Biol. Assoc. iii. 1894, p. 219.

frequently assumed in captivity in order to creep, after the manner of so many Nudibranchs, along the surface-film, a large glandular mass of an orange colour could be seen through the skin in the anterior part of the posterior prolongation of the mantle, where this organ lay beneath the foot. This glandular mass of an orange colour in all probability represents the "rounded brownish-yellow mass" observed by Sars in a similar position and termed by him the liver. The anterior edges of the foot, the dorsal and posterior edge of the tentacles, and parts of the ventro-lateral region of the mantle were ciliated.

The animal consists of a foot, a small tentaculated head, an elevated globose body, and a posterior tail-like pallial appendage.

The Foot.—Sars states that the foot is well-developed and of about the same length as the mantle; that in front it is as broad as the mantle, but becomes considerably narrower behind, and terminates in an obtusely rounded extremity. He further states that its anterior edge is divided in the middle by a deep incision into a pair of lappets with rounded extremities. These statements are perfectly borne out by his figures (pl. xi. figs. 1, 4); but comparison with those supplied by myself shows that a somewhat different interpretation must be made of the anterior parts of the foot. The two lappets, which in Sars's figures are shown to be directed forwards, are not really, as he maintains, the divaricated halves of the anterior part of the foot, but are rather to be regarded as a pair of expansions of the antero-lateral margins of the foot, analogous to the anterior horns of the foot in many Æolids, but differing from the latter in their greater size and obtuse extremities (Pl. XLIV. fig. 2). Sars's figures also indicate that they are capable of being directed forwards; but I never observed them in this position myself, and must regard the condition represented in my figures as more normal than the former. These antero-lateral processes are so considerable that, in view of the affinities indicated by other organs of *Colpodaspis*, I am strongly inclined to regard them as homologous with those pleuropodial[1] expansions so frequently met with among Opisthobranchiate mollusks. This view receives strong support from the fact that in *Haminea hydatis* of the Mediterranean (which appears to be a different species from the *H. hydatis* of British naturalists) the pleuropodia, according to Roule[2], are scarcely developed except on the sides of the anterior region of the body. Here—to judge from Roule's figure—they form elongated obtuse flattened expansions of the foot remarkably like those of *Colpodaspis*, differing only in their greater size and in their power of retroflexion over the back of the body.

[1] The term *pleuropodia* was suggested by me in 1890 as a substitute for the undesirable word *parapodia* as applied to the lateral pedal expansions of Opisthobranch mollusks, and has been accepted by Bergh and other writers (Journ. M. B. A. i. p. 419).

[2] Roule, "Recherches sur les Tectibranches etc.," Ann. Mus. Hist. Nat. Marseille, ii. 1885, Mém. no. 3, p. 22, fig. 13.

The foot, upon this interpretation, must accordingly be described as T-square shaped, with gracefully arched anterior wings and rounded extremities, and of about the same length as the shell-bearing portion of the mantle. The median furrow of its plantar surface is shown in my drawing (fig. 2) to have the same extent as in Sars's specimens.

The Head.—The grooved tentacles in my specimen correspond with Sars's description, except that no mention is made in the latter of a low curved ridge which can be seen in my figure 1 crossing the anterior part of the head from side to side and connecting the postero-dorsal edges of the two tentacles with one another. The eyes also are much closer together in the Plymouth individual than they are represented to be in Sars's figures; and the statement of the latter that they are situated "close behind and within the base of the tentacles" cannot be said to be applicable in the present case. I do not, however, think that any great importance should be attached to these slight discrepancies.

When *Colpodaspis pusilla* is creeping upon a flat surface, the antero-lateral horns of the foot are just perceptibly in advance of the tentacles (fig. 1); but when the creature is swimming inverted at the surface of the water the tentacles are then seen to be considerably in front of the horns of the foot (fig. 2).

The Body.—I have no addition to make to Sars's account of the body proper, except that in the Plymouth specimen the edges of the pallial siphon were more closely apposed than seems to have been the case with Sars's individuals.

Pallial appendage.—When the animal is creeping upon the bottom of a vessel, a broad flattened tail-like appendage projects behind the mantle and seems at first sight to be the posterior section of the foot. Examination of the animal from the ventral aspect, however, reveals that this appendage is in reality a posterior prolongation of the hinder margin of the mantle to the morphological left of the pallial siphon (fig. 2).

Sars adduces no homologue of this peculiar appendage, but it is, in my opinion, to be directly compared with the posterior pallial lobes of various genera of Bulloid Tectibranchs. For example, in *Haminea cornea* Roule[1] writes as follows:—"*.. à sa partie postérieure le manteau devient assez charnu et forme alors une expansion arrondie que de prime abord on serait tenté de considérer comme l'extremité du pied. Cette expansion nous paraît être l'analogue du lobe palléal postérieur de droite que l'on observe chez le* Doridium meckelii, *mais qui serait privé de son flagellum.*"

Forbes and Hanley[2] mistook this pallial lobe for a "supra-caudal (equivalent to opercular) lobe," but they correctly describe it in *Haminea hydatis* as being "large and reflected on the spire."

In *Philine catena* also, according to Roule[3], the mantle terminates posteriorly in a convex margin, a little below which are two fleshy

[1] *L. c.* p. 19.
[2] 'British Mollusca,' vol. iii. p. 542, pl. UU. fig. 3.
[3] *L. c.* p. 36.

prolongations, "which can be mistaken for the posterior border of the foot when the animal is contracted." His figures unfortunately do not show this point at all well (pl. i. fig. 25), and Forbes and Hanley's figure, though clearer, does not seem to represent the anatomical relations correctly (*l. c.* pl. UU. fig. 4).

In *Philine aperta* the plantar surface also consists both of foot and mantle; but this part of the mantle does not correspond with the pallial appendage of *Colpodaspis*, as it contains the viscera and shell. If it be examined, however, from the ventral aspect, the pallial siphon is seen on the left hand, as in *Colpodaspis* (fig. 2), and, to the right of the siphon, the mantle is seen to be prolonged into a short free membranous border, which overhangs the siphonal groove and even extends slightly behind it. The relations of this slight expansion are such that I think it may be regarded as the rudimentary, or probably vestigial, representative of the pallial appendage of *Colpodaspis*.

Radula.—This organ was not described in Sars's original paper, but a figure of it was given (without description) in a later work by G. O. Sars [1]. There is a single admedian series of sickle-shaped denticles on either side, and two series of slender laterals, the formula thus being 2, 1, 0, 1, 2. I was unable to lay open the contracted radula of my specimen, owing to its excessive minuteness; but I determined that the number of rows in the radula was from 25 to 30, and isolated individual denticles and half-rows by teasing with needles. Some of these are drawn as figure 3 of my Plate. The admedian denticles of this radula differ from those figured by Sars in presenting a sharp distinction between their terminal and proximal parts. The handle of the sickle shows an angular projection from its inner or concave edge, like the corresponding denticle in *Colobocephalus costellatus* as figured on the same plate (fig. 16). The lateral denticles also furnish an additional point of resemblance between the radulæ of these two types in that their points are slightly bent in a plane at right angles to that of their general surface, so that, when the denticles are mounted flat upon a slide, their points are directed upwards towards the observer.

Shell.—Sars has described the shell so accurately that I have nothing to add to his description; but my figures, being on a larger scale, represent its form and wonderful delicacy rather better.

Summary.—On the whole, I think this Plymouth specimen presents features which indicate a slight advance on the organization of those described and figured by Sars. I may mention its greater size (3·125 mm. as compared with 2·5 mm.), the greater differentiation of the tentacles, pallial siphon, and admedian denticles, and perhaps some increased extension of the free margin of the shell.

Affinities.—Sars was not quite certain whether *Colpodaspis* belonged to the Opisthobranchia at all, and was much impressed by the fact that the foot is attached to the body by a somewhat

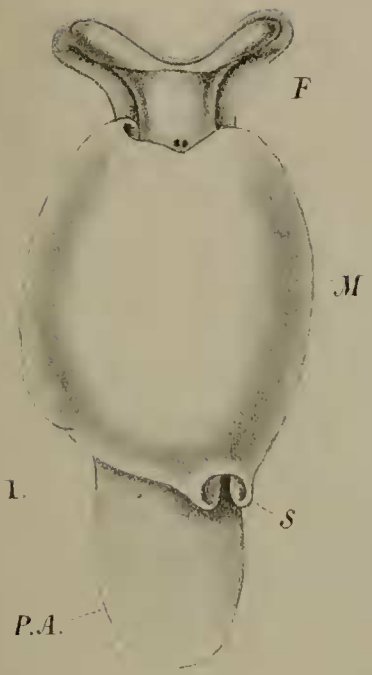
[1] 'Bidrag til Kundskaben om Norges Arktiske Fauna. I. Mollusca Regionis Arcticæ Norvegiæ' (Christiania, 1878), plate xii. (Tabulæ anatomicæ) fig. 15.

narrow stalk—a feature which it shares with most Prosobranchs. Gwyn Jeffreys even informed him that he was inclined to consider *Colpodaspis* as the young of *Cypræa europæa*—a view which now, at any rate, can no longer be entertained.

In spite of our ignorance of the anatomy of *Colpodaspis* we may, however, as a result of the above observations, be certain that *Colpodaspis* is a true Opisthobranch. It resembles various Cephalaspidea in the pleuropodial expansions of its foot (cf. *Haminea*), in the posterior appendage of the mantle (*Haminea*, *Philine*), in its inflated shell (*Haminea*, *Utriculus*), and in its radula (*Philine*). On the other hand it resembles the Notaspidea, and differs from the above types of Cephalaspidea, in the great extent of the mantle and in the form of the head and tentacles. In the latter point it again resembles the Anaspidea, for in the young *Aplysia*, as I have often observed, there is only one pair of tentacles (the anterior one) for a considerable period, and these are grooved just as in *Colpodaspis* and *Pleurobranchus*. These various points of resemblance are all explicable if we regard *Colpodaspis* as a very primitive type of Tectibranchiate mollusk, belonging indeed to the Cephalaspidea, but retaining in an unspecialized condition an unusual number of those primitive characters which the common ancestors of the Cephalaspidea and Notaspidea alike possessed. It supplies an indubitable connecting-link between these two great subdivisions of the Tectibranchia; but it belongs to the group Cephalaspidea, in spite of the inappropriateness of the name, owing to its acquisition of pleuropodial expansions and a posterior pallial appendage—two associated features which are especially characteristic of this group.

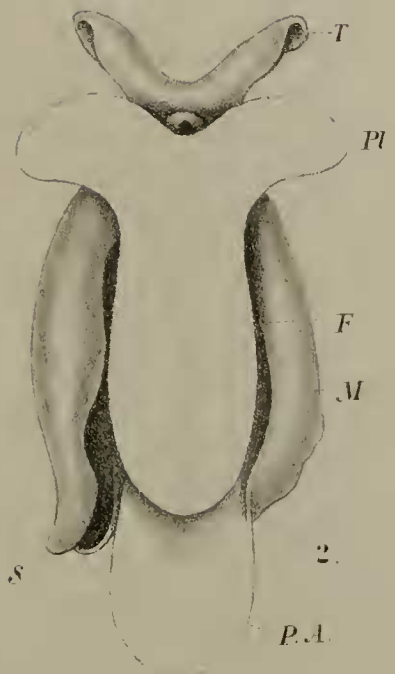
The question still remains open whether or not the creature described by Sars and myself has assumed its adult features. Fischer[1] has suggested that *Colobocephalus costellatus* and *Colpodaspis pusilla* are possibly only young stages of *Philine* or of neighbouring genera of Tectibranchs, owing to the radula in these two types resembling very closely the radula of certain species of *Philine* (*velutinoides*, *lima*, *angulata*). This theory, however, is, in my opinion, altogether untenable in the case of *Colobocephalus*, which, beyond the radula, presents no particularly Cephalaspidean, or even Opisthobranchiate, features. The probability, on the other hand, that the Philinidæ have been derived phylogenetically from a *Colpodaspis*-like ancestor is sufficiently great to render Fischer's view in this case worthy of consideration. The white colour of the body and the early enclosure of the shell by the mantle support this view; but the fact that all the specimens so far taken, which have been captured at such different times of the year as June, August, and February, have been practically identical in structure, and have shown no special approach towards the adult organization of *Philine*, seems to me to render the view improbable. The possession of a similar radula by so different a creature as

[1] 'Manuel de Conchyliologie,' 1887, p. 564.

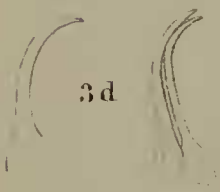


1.

3a.



2.



3d.

3c.

3c.

3b.

4a.

4b.

W. Garstang ad nat. del. R. Mintern lith. Mintern Bros. imp.

COLPODASPIS PUSILLA.

Colobocephalus rather minimizes than supports the view which Fischer has expressed.

EXPLANATION OF PLATE XLIV.

Fig. 1. *Colpodaspis pusilla*, from Plymouth. Dorsal view of the animal creeping upon a flat surface; enlarged.
F. Foot.
M. Mantle enclosing shell.
P. Pallial appendage.
S. Pallial siphon.
2. Ventral view of same, as creeping inverted on the surface-film.
Pl. Pleuropodial expansion.
T. Tentacles.
3. Denticles from the radula of same. Zeiss, Obj. D, Oc. 4, Cam. luc.
a. A half-row, showing the sickle-shaped admedian and the pair of lateral denticles. The apices are recurved upwards towards the observer.
b. Same as *a*, but from the growing part of the radula. The denticles are seen to be connected by a chitinous sheet.
c. Two admedian denticles.
d. Lateral denticles.
4. Two views of shell of same, enlarged.

3. On a singular case of one Snake swallowing another in the Society's Reptile-House. By A. D. Bartlett, Superintendent of the Society's Gardens.

[Received November 5, 1894.]

Since January last, two fine examples of the Common Boa (*Boa constrictor*) have lived together on friendly terms in one of the large compartments in the Reptile-House. One of these, rather the larger, was presented by Messrs. Mole and Urich, Oct. 12, 1892, the other, rather smaller one, was purchased on Jan. 9, 1894.

The Snakes are usually fed at dusk once a week, and on the evening of October 5th, Tyrrell, the keeper of the Reptile-House, placed two pigeons in the den of the two Boa Constrictors. The larger one seized one of the pigeons, and no doubt swallowed it, after which the keeper closed the house and left. On his return the next morning he was astonished to find only one Boa in the compartment instead of two, and from the enormously increased size of the remaining one, he concluded at once that the larger Boa had swallowed its companion. That this was so was evident to all who visited the house. The enormous enlargement of the creature's body was most remarkable. It had no longer the power of curling itself round, as snakes usually do, but remained extended nearly its full length in a straight line, and appeared to be at least three times its normal size in circumference. It was almost painful to see the distended skin, which had separated the scales all over the middle of the body. After examining the snake, my expectation was that it would ultimately disgorge its

companion. I have, however, been disappointed. Recalling to mind a former and very similar case, in which the decomposing body of the snake swallowed caused the death of its destroyer, I had much doubt about the digestive powers of this animal. But in the present instance the snake has not only digested its companion, but has regained its appetite as well as its normal size. On Friday, Nov. 2nd, the keeper, finding the creature moving about as if in search of food, placed a pigeon in its den, which was seized and swallowed immediately.

I have had this voracious serpent measured, and find it to be 11 feet in length. The one which it swallowed was about 9 feet in length. It will be seen by this that a serpent of 11 feet in length can not only swallow and digest another serpent only about two feet shorter, but is ready to feed again twenty-eight days afterwards.

4. On a new Agonoid Fish (*Agonus gilberti*) from Kamtschatka. By R. Collett.

[Received October 29, 1894.]

(Plate XLV.)

I propose to call this new Fish

Agonus gilberti, sp. nov. (Plate XLV.)

Diagn.—*Body very elongate and compressed, the tail everywhere higher than broad. Head* $3\frac{3}{4}$–4 *times in total length (caudal included); height of body* 8 *times. Snout very long,* 3 *times longer than the interorbital space. Barbels on lower side of snout and on the jaws. Teeth in villiform bands on the jaws; none on vomer or palatines. Spines on head and plates on body much as in* A. acipenserinus, *the spines very high and pointed; plates on breast about* 10. *First dorsal begins at the end of 4th scale; 3 scales between the dorsals. Ventrals received in a longitudinal groove. Greyish brown with darker spots; head with shortish bands.*

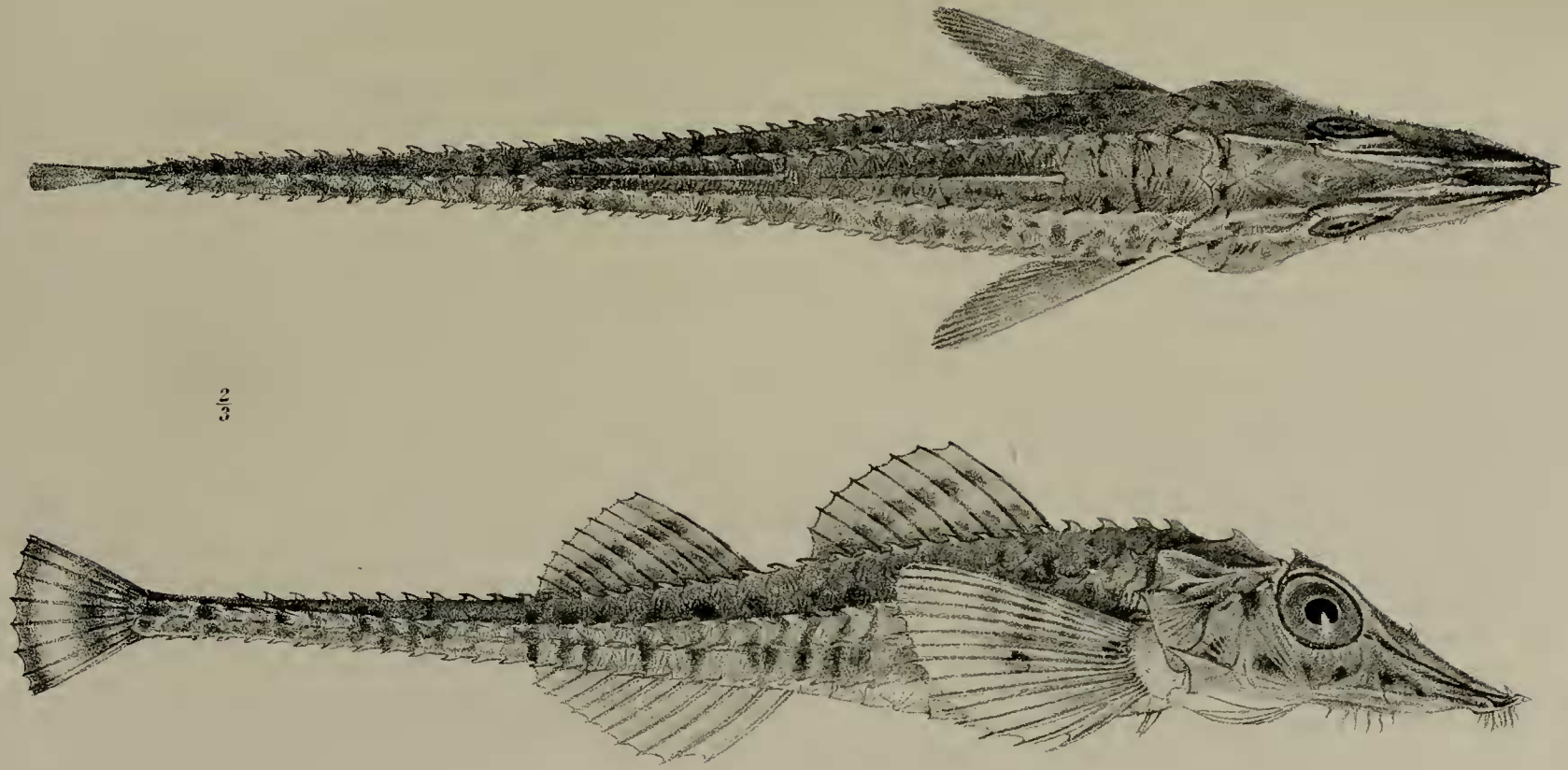
1 D. 8. 2 D. 8–9. A. 10–11. P. 15–17. Lin. lat. 38.

Habitat. Kamtschatka (type specimens in the Christiania Museum).

Description.—*The body* is very elongated and compressed, rather high in front, and tapering to the tail. Its height (from ventrals to first dorsal scale) equals the length of the snout, and is contained in the total length about 8 times.

The tail is compressed, long and slender; its height everywhere greater than its breadth.

The head.—Its length is contained in full-grown specimens 4 times, in younger ones about $3\frac{3}{4}$ times in the total length (caudal included).



F W Frohawk del. et lith.

Mintern Bros imp

AGONUS GILBERTI.

Thus in four specimens of different sizes the proportions are the following :—

Total length 183 millim.	Head-length	3·66 times.
Total length 254 millim.	„	3·73 „
Total length 277 millim.	„	4·01 „
Total length 290 millim.	„	4·02 „

Snout very long, 3 times longer (or more) than the interorbital space (between the bases of the supraocular spines).

Posterior part of the head comparatively smooth, the interorbital space rather concave; no quadrangular pit on the occiput in front of the dorsal scales.

Eye comparatively large; the horizontal diameter a little larger than the vertical. It is contained a little more than 2 times in the length of the snout, and rather more than 4 times in the length of head.

Cirri on lower side of snout (in front of the premaxillary) and at the angles of the jaws [1]. Their length equals that of the eye.

Mouth entirely inferior; distance from premaxillaries to tip of rostral spines about equal to the length of the eye.

Teeth in the jaws; vomerine or palatine teeth none.

Armature of the head.—Much like that of *A. acipenserinus*. The rostral spines 4, two projecting horizontally forwards, two (behind the first) curved backwards. A third pair on the snout (much nearer the eye than the rostral spines).

Orbital ridge with a single spine (supraocular, no preocular); the lower ridge finely serrated.

Occipital ridges, operculum, and preoperculum as in *A. acipenserinus*, but the spines more pointed and longer.

Suborbital with a double ridge at its lower margin, the upper ridge with two distinct spines behind, and a third (sometimes indistinct) at equal distance from the eye and the tip of the snout.

Head with about 18 distinct spines altogether.

Armature of body.—Plates on the back and sides of the same number as in *A. acipenserinus*, but the spines are longer and curved more backwards, and strong everywhere from head to caudal. Between the two dorsal keels and between the two lateral keels there are no traces of another keel (as in *A. valsus*).

Breast with about 10 polygonal plates, 4 of which form a series on each side and 2 a median series; bases of pectorals and ventrals also surrounded with plates. All the plates have a short spine in their centre.

Dorsal plates numbering :—

		Plates.
From occiput to first dorsal	(Pair)	4
First dorsal extending over.....	„	8
Between the dorsals.....	„	3
Second dorsal extending over.....	„	9+1
From second dorsal to caudal.....	(Single)	15

[1] All the specimens are in a bad state of preservation and most of the barbels are lost.

The dorsal keel (coalescing with the keel on the other side at the 15th plate in front of the caudal fin) is consequently composed of 38 to 39 plates; the lower lateral keel, extending from lower base of the caudal to base of the 10th pectoral ray, contains 35 plates.

Abdominal plates numbering:—

		Plates.
From ventrals to anal	(Pair)	11
The anal extending over	,,	10
From anal to caudal	(Single)	17

The abdominal keel (coalescing at the 17th plate in front of the caudal) is formed by a series of 38 plates.

Lateral line distinct; 38 pores.

Fins.—In the 10 specimens, at present preserved in the museum at Christiania, the fin-rays are the following:—

1 D.	2 D.	A.	P.
8	8	10	17–17
8	9	10	? 16
8	9	10	16–16
8	8	10	15–16
8	8	10	17–17
8	8	10	17–17
8	8	10	16–17
8 (+1)	8	11	16–17
8	8	10	15–16
8	9	10	17–17

First dorsal begins behind the fourth dorsal plate and has 8 rays (one specimen has an additional slender ray in the space between the two dorsals). Its height equals its distance from the head. It extends over 8 scales; the first two rays in the space between the fourth and fifth plate.

The dorsal fins are separated by 3, sometimes by 4 plates.

Second dorsal has 8, sometimes 9, rays, and extends over 8 plates; behind the last ray is one pair of plates, before the unpaired series begins.

Anal has commonly 10 rays (in one specimen 11); its height equals that of the 2nd dorsal, and is rather less than that of the 1st dorsal. It commences between the 11th and 12th pairs of scales in the abdominal series.

Ventrals short in the female, shorter than the vertical diameter of the eye; longer in the male, equalling the length of the snout. Each has one short spine and three articulated rays, two of which are divided to their base. They are received in a longitudinal common groove ("*Podothecus*").

Pectoral has 16–17, rarely 15 rays, some of which are sometimes branched in their upper half, but not always. The first ray is short, about equal to half the second ray; the lowermost rays a little thicker than the rest. Its form is a little emarginate, the 5th lower ray being a trifle longer than the 6th and 7th. The tip extends to a distance from the anal of 2 or 3 plates.

Colour.—Greyish brown, with dark spots and shortish bands: belly whitish.

On the upper part of head the spots form longitudinal bands—one of these (single) running down in the median line of front, between the eyes. A second (and more distinct) band extends on each side of the snout from the tip to the anterior margin of the eye, hence running under the orbital rim; in some specimens it is continued as a narrow ring round the eye, but commonly this is broken and indistinct.

On the opercles and sides of the snout the spots are roundish and well marked.

On the body also the spots are roundish, rarely oblong, their size equalling that of the pupil. They are darkest and most distinct on the back, being sometimes almost obliterated on the sides.

The colour of the fins is rather indistinct in the badly-preserved specimens before me. The pectorals have a dark oblong spot at their bases (from about 6th to 11th ray); the dorsals have two dark bars, separated by whitish, and with the tip in 1st dorsal also blackish (in 2nd whitish). The caudal has a dark cross-bar a little behind the base, and a dark margin. The anal is apparently whitish to the margin in the female; in the single male specimen at least the outer half is blackish.

Measurements (in millimetres).

Nos. 1 to 9 are females, No. 10 is a male.

No.	Total length. (C. incl.)	Length of head.	Height of body.	Snout to anus.	Snout to dorsal.	Diameter of eye.	Length of snout.
1 ...	183	50	22	48	61	9	26
2 ...	254	68	35	66	84	15	34
3 ...	258	64	31	64	80	14	31
4 ...	263	63	31	60	81	14	32
5 ...	263	65	30	61	80	14	31
6 ...	270	68	33	64	84	15	34
7 ...	274	68	31	69	86	15	34
8 ...	277	69	35	70	86	16	34
9 ...	290	72	32	72	89	16	38
10 ...	258	63	30	65	80	14	31

Ova.—Several of the females were filled with ripe ova; their number in the two ovaries together about 3000. The roe had a diameter of 1·2 millim.

Locality.—Kamtschatka. In 1879 the museum of Christiania received from Consul Henry Lund in San Francisco a small collection of fishes and marine invertebrates, collected by a Norwegian sailor at Kamtschatka. Amongst the first were 12 specimens of this species, some of which were rather defective and in a bad state of preservation. All except one were full-grown specimens. The exact locality was not given.

Remarks.—*A. gilberti* is allied to *A.* (*Podothecus*) *acipenserinus*, Tiles. 1810, but differs from that species in several characters, viz. :—

The more elongated body. In *A. gilberti* the end of the 2nd dorsal is midway between the caudal and the middle of 1st dorsal; in *A. acipenserinus* between the caudal and the beginning of the 1st dorsal.

The more compressed body. From head to caudal everywhere higher than broad; in *A. acipenserinus* much broader than high.

The longer snout. The interorbital space is contained 3 times in the length of the snout; in *A. acipenserinus* a little more than twice.

Dorsals more separated; interdorsal space with 3 or 4 plates, in *A. acipenserinus* only 1 plate (sometimes 2), or the fins almost contiguous.

Ventral groove present in *A. gilberti*, absent in *A. acipenserinus*.

Colour with distinct stripes on head and spots on body; in *A. acipenserinus* cross-bars on the body, the head being almost unspotted.

The other species of the same subgenus, *A.* (*Podothecus*) *valsus*, Jord. and Gilb. 1880, has the body everywhere broader than high. The spines of the head are more numerous (more than 70 spines and tubercles on the head); there is a deep quadrangular pit on the occiput; no barbels on lower side of snout; the 1st dorsal commences behind the seventh dorsal plate, and the fin-formula is different.

The genus *Podothecus* was established by Gill in 1861[1] for a species called *P. peristethus*, which is commonly believed to have been based on a badly-preserved specimen of *A. acipenserinus*. But it must be borne in mind that one of the characters of the said genus (the very one from which the name is derived), "ventral fins received in a long lanceolate groove," is not shown by *A. acipenserinus*.

As other essential characters of the genus are mentioned "the longer spinous dorsal and the greater number of plates on the breast."[2] None of these characters, however, are of sufficient importance to justify the establishment of a new genus.

As another character for *Podothecus*, Jordan and Gilbert state[3]

[1] Proc. Acad. Nat. Sci. Philad. 1861, p. 258.

[2] Proc. U.S. Nat. Mus. vol. iii. 1880, p. 332.

[3] "Synopsis of the Fishes of North America" (Bull. U.S. Nat. Mus. no. 16, p. 714, Wash. 1882).

"that the gill-membranes are united to the isthmus, not forming a fold across it." But this character is not always constant. The museum of Christiania has three specimens of *A. acipenserinus*, received through the kindness of Dr. Gilbert from the Stanford University, Cal. In two of these the gill-membranes form a short but distinct fold across the isthmus; in the third it is hardly perceptible. In *A. gilberti* some of the specimens show a trace of a similar fold, whilst in others the isthmus is smooth.

A. decagonus, Bl. Schn. 1801, forms another transitional stage between the last group and the other, in which the gill-membranes form a distinct fold across the isthmus (as in *A. cataphractus*). In the first species the fold is always present, but very short.

Consequently *Podothecus* can hardly rank as a *genus*, but forms in the typical genus *Agonus* a group of species which, by the structure of the snout and the dentition, may be separated from all *Agonidæ*.

Christiania, Oct. 1894.

5. On the Anatomy of *Atherura africana* compared with that of other Porcupines. By F. G. Parsons, F.R.C.S., F.Z.S., F.L.S., Lecturer on Comparative Anatomy at St. Thomas's Hospital.

[Received October 12, 1894.]

The specimen of *Atherura africana* from which the accompanying notes were made was kindly placed at my disposal by Mr. F. E. Beddard, Prosector to the Society. I was induced to make a rather more exhaustive examination of certain parts of it than I otherwise might have done because I hope that some day I may have the chance of dissecting its Eastern relative, *Atherura macrura*, and of comparing the anatomy of the two. Professor Mivart's account of the anatomy of *Erethizon dorsatum* was of great value in comparing *Atherura* with the Tree-Porcupines; but I was unable to find a complete account of a dissection of a Ground-Porcupine, and am indebted to Professor Stewart for the gift of a spirit-specimen of a young *Hystrix cristata*, which I dissected *pari passu*. I am also indebted to Professor Howes and to Mr. Oldfield Thomas for their kindness in allowing me the use of their osteological collections.

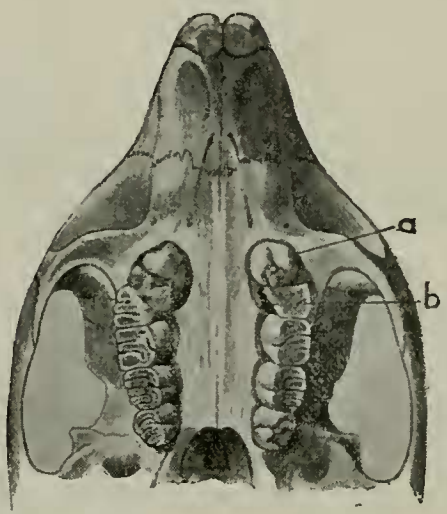
Osteology.

The skull of *Atherura* has already been described by Gray[1] and by Günther[2]. The former gives the chief characteristics of it and

[1] P. Z. S. 1847, p. 104.
[2] P. Z. S. 1876, p. 743.

describes the teeth; the latter figures the base of the skull in *A. africana* and *A. macrura*, and mentions several points by which they can be distinguished. The teeth of the animal I examined agree with Gray's description, except that I was unable to make out any folds on their hinder edge. The premolars were in the process of being replaced by the permanent teeth, and this process was much further advanced in the upper than in the lower jaw. As I believe that the date of the shedding of the milk-premolars is unknown, it may be worth recording that the following epiphysial lines could be distinctly made out:—Upper end of humerus, lower end of femur, tip of olecranon, lower end of radius, upper and lower ends of tibia, lower end of fibula, hinder margin of ramus of ischium. The epiphysis for the crest of the ilium had practically disappeared.

Fig. 1.



Base of Skull, showing the temporary premolar tooth being replaced by the permanent one.

a. Permanent premolar.
b. Temporary premolar.

In addition to the points noticed by Gray and Günther, which it is unnecessary to recapitulate here, there are one or two others which seem of value in distinguishing the skull. In the first place, in *A. africana* the frontal bone projects forward as a triangular spine for some little distance between the nasal bones. This characteristic was noticed in six out of seven skulls of *A. africana*, while in only one out of four specimens of *A. macrura* was it present. All the other Porcupines which I have examined have a straight suture between the nasals and the frontal.

In *A. africana* the suture between the malar bone and the maxilla is much further forward than in *A. macrura*, its distance from the nearest point of the great infraorbital foramen being from $\frac{1}{8}$ to $\frac{1}{4}$ in., while in *A. macrura* it is considerably over $\frac{1}{4}$ in.

Another point worthy of notice is that in 4 out of 6 skulls of *A. africana* an os antiepilepticum or Wormian bone at the junction of the coronal and sagittal sutures was present. In four skulls of *A. macrura* it was not seen once [1].

The cervical vertebræ are remarkable for the large and recurved spine of the atlas. The sixth shows a large ventral tubercle on the transverse process corresponding to the carotid tubercle of human anatomy. In the seventh this tubercle is suppressed.

The thoracic vertebræ are 14 in number, the anticlinal being the 13th. The transverse processes gradually broaden and tend to bifurcate until at the 8th there is a fairly distinct metapophysis projecting from the anterior part and an anapophysis from the posterior.

The lumbar vertebræ (fig. 2, p. 678) are 5. The anapophyses are well marked until the last one, where they disappear [2]. Ventral to the disc between the first and second vertebræ are two ossific nodules about the size of pins' heads, which apparently are serially homologous with the chevron-bones in the caudal region, and probably correspond to the intercentral in the Mole, although I believe that these structures have not yet been described in Rodents. In another specimen which I examined I found these nodules between the 2nd and 3rd, 3rd and 4th, and 5th and 1st sacral [3].

The sacral vertebræ are sometimes three, sometimes four. All the costal processes are completely fused into a horizontal plate, while the spines are only slightly fused. In the structure of the sacrum *Atherura* agrees with *Hystrix* and differs considerably from the Tree-Porcupines.

There are 24 caudal vertebræ, the first four of which have projections from the ventral surfaces of the costal processes. Between the last sacral and first caudal vertebræ chevron-bones are seen as small nodules. Between the first and second caudals there is a small hæmal arch ending ventrally in a point; beyond this the hæmal spines broaden out anteriorly but are compressed laterally; there are altogether 16 of them.

The sternum consists in one case of five and in another of six sternebræ. In front of the anterior one there is a leaf-shaped cartilage. The anterior sternebra or manubrium is remarkable in the animal I dissected in that the first and second costal cartilages

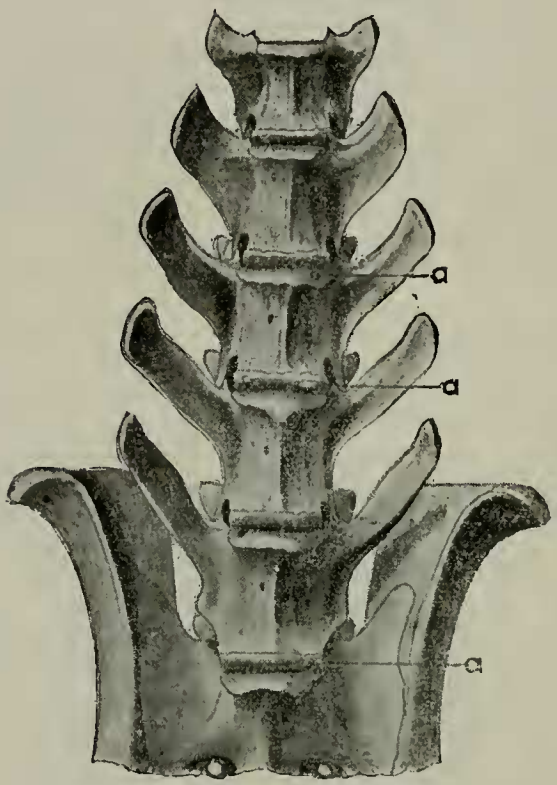
[1] W. Gruber in 'Mémoires de l'Académie de St. Pétersbourg,' xix. no. 9, describes the presence of this bone in several Rodents, but not in Porcupines.

[2] In another specimen they were absent in the last two.

[3] The occurrence of these paired intercentra is interesting when compared with a paper by Boulenger, P. Z. S. 1891, pp. 114 & 170. In it he points out that, in Lizards, the intercentra or hypapophyses may be either paired or median.

are attached to it, close together, about its middle[1]. In all other Porcupines the second rib is attached to the junction of the first and second sternebræ, as it is in most other mammals.

Fig. 2.



Lumbar Vertebræ, showing the position of the intercentra.
a a a. Intercentra.

The xiphisternum is long and narrow and tipped with a crescentic piece of cartilage.

There are fourteen ribs, of which eight are vertebro-sternal, two vertebro-costal, and four vertebral.

The clavicle is thin and curved and is cartilaginous at each end. Internally a rod of cartilage half an inch long connects it with the sternum, while externally there is a leaf-shaped cartilage which overlaps the coracoid process. The clavicle is firmly attached to the coracoid by the coraco-clavicular ligaments, but there is practically no connection between it and the acromion.

[1] In another specimen at the British Museum, the second cartilage was in its normal position.

The scapula is remarkable for the straightness of the axillary border, which always shows more or less of a curve in the other Porcupines. The metacromial process is flat and triangular and fairly broad at its base; it is situated at the extreme end of the spine, and the acromion is aborted beyond it. This arrangement is the same in *Hystrix* and *Erethizon*, but differs from *Sphingurus*, where the metacromion is some distance from the tip of the acromion.

The humerus closely resembles that of *Hystrix*; it differs from that of the Tree-Porcupines in the patency of the supratrochlear foramen.

The radius is more arched than in *Hystrix*, but less so than in the Tree-Porcupines. The grooves for the radial extensors of the wrist and the extensor ossis metacarpi pollicis are well marked.

In the ulna the lower epiphysis is united to the shaft; it ends in a well-marked styloid process which fits like a pivot into the cuneiform bone. In adult specimens of *Erethizon* and *Sphingurus* the lower epiphysis of the ulna was separate.

The first row of carpal bones consists of a scapho-lunar, cuneiform, and a large pisiform. The radial sesamoid lies across the palm and articulates with the scapho-lunar. The bones of the second row are normal except that, owing to the smallness of the unciform, the 5th metacarpal articulates largely with the cuneiform. The phalanges of the thumb are distinct as they are in *Hystrix*. In *Erethizon* and *Sphingurus* they are fused together.

The os innominatum resembles that of *Hystrix* in the prominence of the anterior and posterior ventral spines (corresponding to the anterior superior and anterior inferior spines of human anatomy), in the length of the symphysis pubis, and in the pyriform shape of the obturator foramen. The iliac surface is narrow and looks downward. In the Tree-Porcupines the iliac surface is broader, the spines less marked, the symphysis shorter, and the obturator foramen more rounded.

The femur of *Atherura* agrees with that of *Hystrix* and differs from that of the Tree-Porcupines in that the trochanters project more and the digital fossa is deeper. A third (gluteal) trochanter is only present in *Erethizon*.

There are two fabellæ in *Atherura*.

The tibia, as in all Porcupines, shows a prominent cnemial crest about the middle of the shin.

The fibula is broad and flat above but soon becomes prismatic below; it articulates at both ends with the tibia and below with the astragalus.

The tarsus shows a calcaneum singularly flattened from above downward, forming a very deep groove for the flexor longus hallucis.

The navicular, as in all Porcupines, consists of two portions lying side by side; articulating with the inner one there is a large triangular bone, presumably the prehallux, which is folded under

the sole, lying beneath the head of the astragalus instead of projecting from the inner side of the foot as in the Tree-Porcupines. There are three cuneiforms and a cuboid.

The two phalanges of the hallux are distinct, as they are in *Hystrix* and *Erethizon*; in *Sphingurus* they are fused together.

The Muscular System.

The muscles of *Atherura* were found to resemble very closely those of *Hystrix*, described in the "Myology of the Sciuromorphine and Hystricomorphine Rodents."[1] In that paper I stated that I had only noticed two definite muscular characteristics of the Hystricidæ as a family :—

1. The latissimus dorsi at its insertion wraps round the lower border of the teres major.

2. The scalenus anticus is absent.

Both of these points are noticeable in *Atherura*.

The points of difference suggested between the Tree- and the Ground-Porcupines were much more numerous, and I have carefully tested them on *Atherura* :—

1. The digastric agrees with *Hystrix* in only having a slight constriction between the two bellies, in this constriction a thin layer of tendinous fibres is found on the surface. It differs from *Sphingurus* in not having a strong tendinous slip from the posterior belly to the hyoid bone.

2. The omo-hyoid is absent, agreeing with *Hystrix*, in which it is either absent or rudimentary, and differing from the Tree-Porcupines, in which it is a large muscle.

3. The levator claviculæ rises from the basioccipital bone as in *Hystrix*. In the Tree-Porcupines it comes from the atlas.

4. The sterno-scapularis rises from the first part of the bony sternum, not the leaf-shaped cartilage. A few fibres go to the outer part of the bony clavicle, the rest are continued as the clavicularis, which runs to the spine of the scapula but only covers the outer part of the supraspinatus. This arrangement corresponds with that found in *Hystrix*, in which the two parts of the sterno-scapularis are continuous, in *Sphingurus* they are practically separate.

5. The biceps cubiti has only the long head as in *Hystrix*. In the Tree-Porcupines both heads are present.

6. The coraco-brachialis is inserted from just below the insertion of the latissimus dorsi to just above the internal condyle by one continuous attachment. The musculo-cutaneous nerve passes through the muscle, *i. e.* a few fibres which are inserted lowest pass superficial to it. If we regard the musculo-cutaneous nerve as the separation between the second and third heads of the coraco-brachialis, both these heads are present in *Atherura*, and

[1] P. Z. S. 1894, p. 251.

in this respect it differs from *Hystrix* and agrees with the Tree-Porcupines.

7. The brachialis anticus consists of two parts as in *Hystrix*, but these two parts are closely blended. In *Sphingurus* only the external or long head is present.

8. The extensor secundi internodii pollicis is absent in *Atherura* as it is in the Tree-Porcupines. It was found in *Hystrix*.

9. The pyriformis is present, as in the Tree-Porcupines. It is absent in *Hystrix*. I am not inclined to place any great reliance on the presence or absence of this muscle, as it seems occasionally to miss its attachments to the sacrum and to rise from the upper margin of the great sciatic notch ; in these cases it becomes so closely connected with the gluteals as to be almost indistinguishable.

10. The biceps femoris consists of two parts, as in the Tree-Porcupines.

11. The peroneus quarti digiti is present as in *Hystrix*. In the Tree-Porcupines it is wanting.

It will thus be seen that in most of these points *Atherura* agrees in its musculature with *Hystrix*, although in a few it approaches that of the Tree-Porcupines.

Further observation is, however, necessary in order to eliminate individual variation, and to determine which muscles are really valuable for classificatory purposes.

The rest of the muscles were examined, but were found to correspond so closely with those of *Hystrix* that it would be almost a recapitulation of that animal to describe them in detail.

The Digestive System.

The *tongue* is long and narrow, and is marked by a median furrow which is most distinct in the anterior part. The anterior third of the dorsum is covered by transverse rows of horny scales, the free edges of which are directed backwards and are serrated, but not so deeply as in *Hystrix*. There are usually three scales in each row. The posterior two-thirds of the dorsum of the tongue is covered with fine, backwardly directed, filiform papillæ, which give the organ a velvety appearance. The fungiform papillæ occur on each side of the median furrow, but are most numerous in the anterior and posterior thirds of the organ. There are two circumvallate papillæ. The papillæ foliatæ consist of about ten parallel vertical slits, their posterior margin extending as far back as the level of the circumvallate papillæ.

On the under surface of the tongue the fungiform papillæ are seen to extend over the tip and, with some of the filiform, to cover about a quarter of an inch of the lower surface. The rest of this surface is quite smooth.

On comparing the tongue of *Atherura* with that of *Hystrix*

cristata and *H. javanica*, it will be noticed that the general resemblance is very great. The chief points of difference are:—

1. That the scales are more deeply serrated in *Hystrix*.
2. That the fungiform papillæ are more numerous.
3. That the foliate papillæ have more ridges and grooves. In the specimen of *H. javanica* examined there were sixteen parallel grooves, while in that of *H. cristata* there were twenty. I do not know whether the number of ridges and grooves in the foliate papillæ is constant in different individuals of the same species.

The tongue of *Erethizon dorsatum* described by Mivart[1] differs a good deal from that of *Atherura*. There is no median groove except at the hinder margin, while the serrated scales so remarkable in *Atherura* and *Hystrix* are not noticeable.

Buccal cavity. On each side of the mouth there is a small cheek-pouch lined with hair, and opening between the incisor and premolar teeth.

The *pharynx* is a continuation of the œsophageal tube up to the posterior nares. There is a small round opening into the mouth in its anterior wall, just above the laryngeal aperture. There is no uvula.

The *œsophagus* is narrow above and is remarkable for the thickness of its mucous membrane.

The *stomach* is simple and resembles that of Man in its shape; it differs from *Hystrix cristata* and *javanica* in the absence of the sacculus, and from that of *Erethizon* in not being bent on itself and in its less elongated form.

The pylorus has a very thick muscular ring with a calibre only large enough to admit a small quill. Immediately to the outer side of this is the opening of the large bile-duct.

The *pancreas* is a solid tongue-like gland situated behind the stomach; as the viscera were somewhat decomposed before they came under observation, I failed entirely to find the pancreatic duct or its place of opening.

The *spleen* resembles that of *Hystrix* in being a tongue-like gland, without any notches, situated close to the great *cul-de-sac* of the stomach. Its total length is $3\frac{1}{4}$ inches. In *Erethizon* this organ is oval.

The *duodenum* forms a large open loop, its calibre at first is very great, but it narrows rapidly.

The *great omentum* is about 1 inch long, it reaches a little beyond the umbilicus, but not as far as the bladder.

The *small intestine* is 15 ft. 4 in. long, including the duodenum.

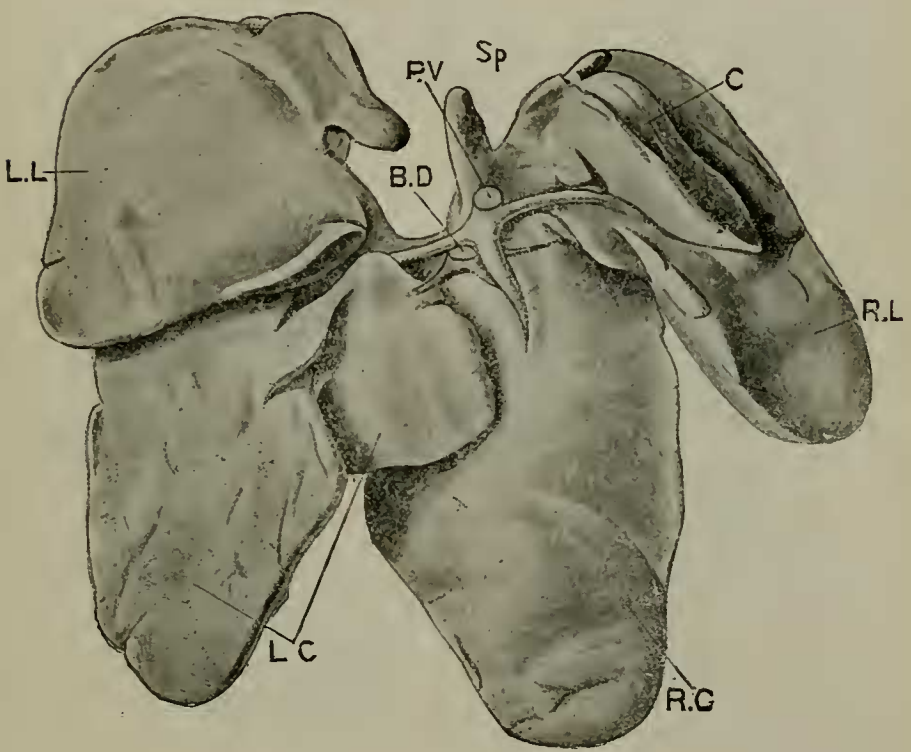
The *cæcum* is very much shorter than in *Erethizon*, being only $7\frac{1}{2}$ inches instead of 28. The ileo-cæcal valve is an oval opening $\frac{1}{4}$ inch long, the lips of the valve are slightly patulous. There is no sacculus rotundus and no constriction as in *Erethizon* at the place where the cæcum joins the colon. The mucous membrane

[1] P. Z. S. 1882, p. 271.

is puckered, but there is no appearance of a spiral valve. The three longitudinal muscular bands are well marked on the outside, but disappear in the colon; one of them marks the attachment of a mesentery which is continuous with the mesocolon and which maintains the horseshoe curve of the cæcum. Sacculations between the bands are well marked.

The *large intestine* measures 34 inches from the ileo-cæcal valve to the anus; its muscular coat is quite smooth, as is also its mucous coat. Several round or oval agminated glands are seen in the mucous membrane.

Fig. 3.



Posterior surface of the Liver.

L.L. Left lateral lobe.	*C.* Caudate lobe.
L.C. Left central lobes.	*Sp.* Spigelian lobe.
R.C. Right central lobe.	*P.V.* Portal vein.
R.L. Right lateral lobe.	*B.D.* Bile-duct.

The *liver* (fig. 3) agrees in its lobulation very closely with that of *Hystrix cristata* and *javanica*. As in these animals, the right central lobe is larger than the right lateral, while the left central has a small portion near the middle line of the liver cut off, so that

in the Ground-Porcupines there are practically two left central lobes, a large one externally and a small one internally. I found no gall-bladder in *Atherura* or in the specimen of *Hystrix cristata* with which I compared it, but the liver of *H. javanica* in the Museum of the College of Surgeons shows a very large and somewhat sacculated one. In *Erethizon*[1] the left central lobe is undivided, and the right lateral is as big as, if not bigger than, the right central. In this specimen also there was no gall-bladder[2].

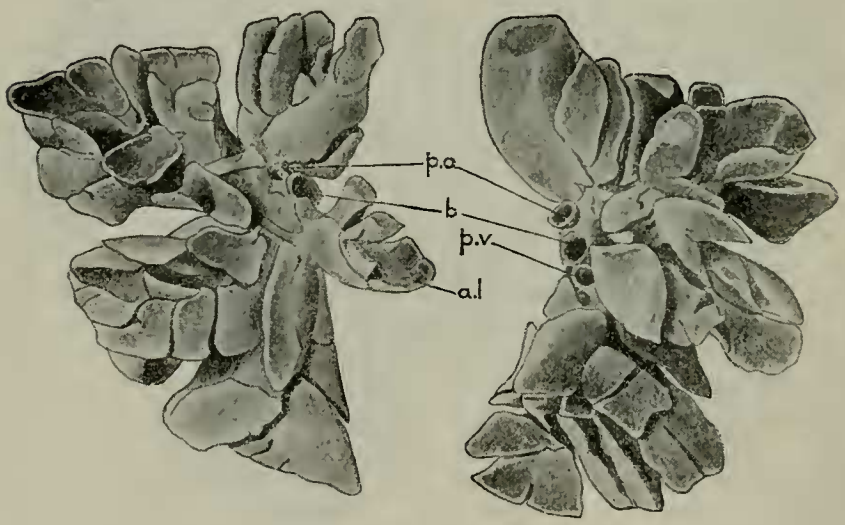
The *kidneys* are smooth on the surface, and on section show several papillæ; the right one is, as usual, in advance of the left.

Circulatory and Respiratory Systems.

The *suprarenals* are closely adherent to their respective kidneys. On section they show a yellow cortex and a red medulla.

The *thymus* is large.

Fig. 4.



The Lungs from the front.

a.l. Azygos lobe.	*p.v.* Pulmonary vein.
p.a. Pulmonary artery.	*b.* Bronchus.

The *larynx* is remarkable for the great size of the cricoid as compared with the thyroid cartilage. The epiglottis is broad and notched; on its laryngeal surface is a vertical ridge corresponding

[1] P. Z. S. 1882, p. 276.

[2] Neither is there any in *Sphingurus*.